

# Emission99

a module in Route99



[www.nms2002.com](http://www.nms2002.com)

A tool to assist owners and operators in

Calculating the emission created from their fleet operations and how to minimize the costs of these



NORWEGIAN  
MARITIME  
SOFTWARE

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## Emissions from ships is a new factor to take into account for all shipowning and operating companies

- ☞ Shipping activities contribute significantly to the air pollution all over the world.
- ☞ Gases that effect climate change include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O). Ship engines also produce other air pollutants such as carbon monoxide (CO), oxides of nitrogen (NO<sub>x</sub>), non-methane volatile organic compounds (NMVOCs), particulate matter, and sulphur dioxide (SO<sub>2</sub>).
- ☞ The amount of emissions produced is primarily a function of
  - the amount of fuel consumed,
  - the characteristics of the fuel,
  - the engine technology employed, and
  - any post-combustion emission controls in place.

## Emission99

- ☞ **Emission99** is a software program that will estimate emissions a fleet of vessels generate when it is scheduled on a commercial basis.
  - Trades and cargoes are specified by load port, discharge port, cargo intake, freight rate etc
  - Ships are specified by speed, fuel consumption, dwt, NOX, CO2, SO2 and other parameters.
  - Route99 wil first calculate all voyages with days at sea, days in port, cargo loaded, freight revenue and TC result pr day for each voyage.
  - **Emission99** will then calculate the total amount of fuel consumed and the total kwh output of engines
  - Estimate the emissions based on data for the fuel type and the engine specifications.
  - If costs for emissions are specified, **Emission99** wil take this into consideration when finding an optimal schedule for the fleet.
- ☞ In a study by Marintek from 2000, it is estimated that more effective scheduling can reduce emissions substantially by upto 40 % and also contribute to a much higher income on tc basis.

## Route99 is an integrated software program containing the following modules:

### ☞ VOYEST99

- A comprehensive voyage estimator that calculates TC equivalent and other key parameters

### ☞ POOL99

- Allows a number of calculations of chartering pool arrangements, pool points, profit for distribution etc

### ☞ OPTI99

- Is a powerful optimizer that can start with a blank schedule and thereafter find a schedule allocating cargoes to ships so that the fleet result gives the best profit but at the same time respecting all constraints

### ☞ EMISSION99

- Is a module that can calculate emissions and the costs of emissions in a commercial framework

### ☞ VOYACC99

- Is a complete voyage accounting module that allows recording actual info such as cargo loaded, time in port etc.

## Route99 is an integrated software program containing the following modules:

### ☞ COADIGIT99

- Digitizing of Contracts so that the data for rates, loadports, disch ports, handling terms, bunker clauses etc can all be read in a digitized form for further processing, voyage calculations and other processing

### ☞ ROLLBUDGET99

- Rolling budget

### ☞ TONNAGEBUDGET99

- Processing of loading and discharging plan. Also generating position lists and synchronizing these with any changes in the tonnagebudget

### ☞ EMPLOYMENT99

- Processing and finding optimal employment budgets. Typically for car carriers, container services, cruise itineraries and other semi-liner/full-liner operatios where the tool provides a flexible tool to analyse altermive scehdules and the net impact of these

## The first objective: Operators must be able to estimate what emissions their scheduling produce

- ☞ Few shipping companies have had any focus on the emissions or pollutions that their operation create.
  - User can check consistency with MARPOL Annex VI 73/78 standard
- ☞ **Emission99** will enable operators to estimate the emissions based on their projected trading.
- ☞ By using **Emission99** the operators can project what impact new governmental or national tariffs on emissions will have on their operation
- ☞ Scheduling of ships have traditionally taken into account trivial factors such as Port costs, canal charges, fuel expenses and handling costs. Now they will also have to deal with cost of emissions. These costs will take various forms that will make scheduling a lot more complicated. This is where **Emissions99** will assist.

# The scheduling task will get more complicated

**Route99**

Traditional factors to include:

- Port costs
- Fuel cost
- Handling costs
- Canal costs

**NEW FACTORS to include:**  
**Cost of emissions**

**Fleet and TC ships**

**Contract and spot cargoes**

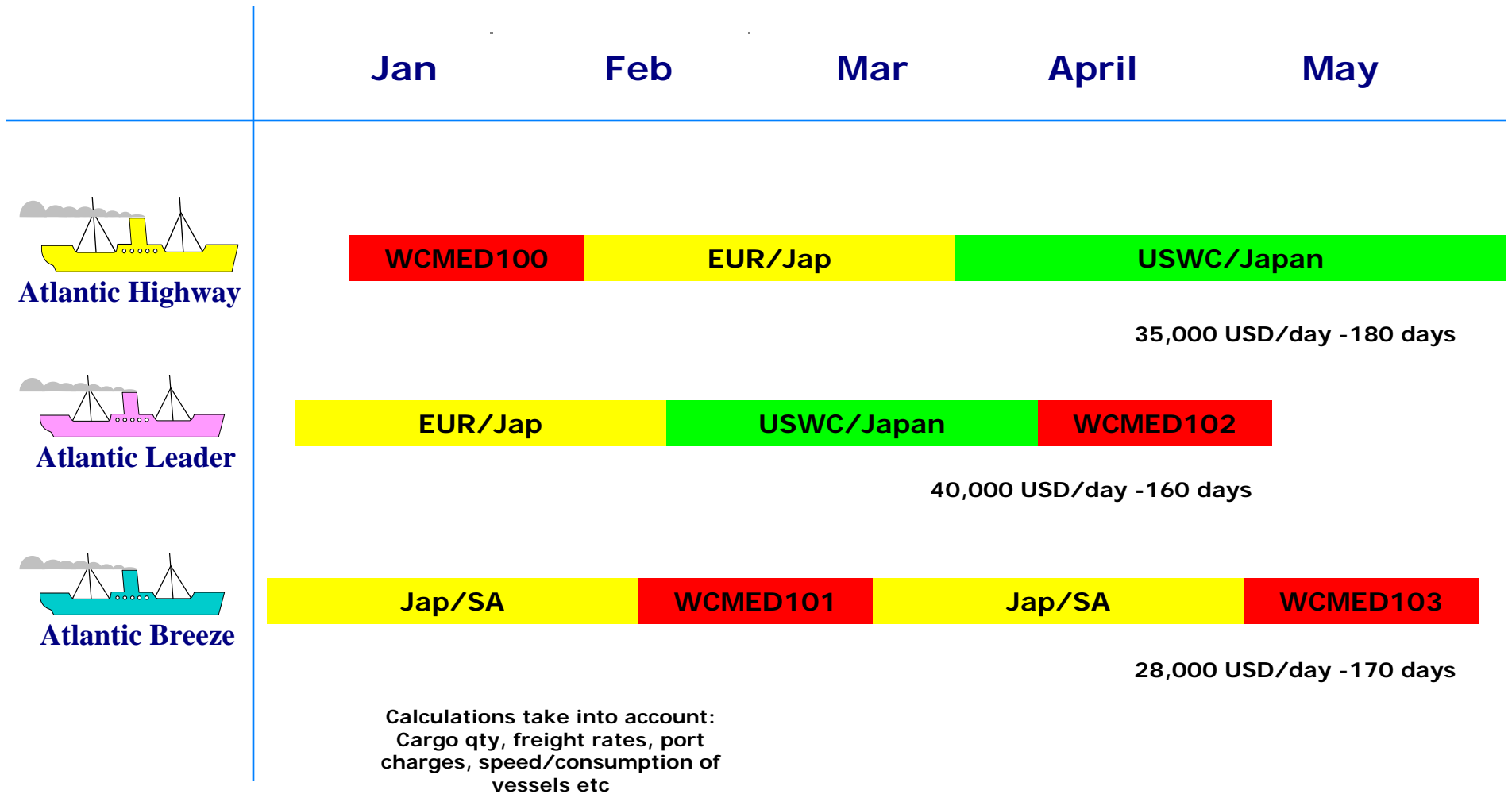
**Task: Find a schedule for the fleet that maximizes the total TC result taking into account the cost of emissions**



## Emission99 – Steps in typical usage

- ☞ **Step 1 – Make a commercial fleet schedule (1 to 12 months period)**
  - Calculating voyage estimates for all cargoes and ships in the fleet
- ☞ **Step 2 – Calculate the quantity of emissions from such schedule**
  - Provide management with an estimate of what pollutants the fleet is generating
- ☞ **Step 3 – Calculate the cost of emissions**
  - These can be costs as they are today or future expected costs that will be imposed on the shipping industry
- ☞ **Step 4 – Let Emission99 find an "optimal" schedule that maximizes the fleet's TC result and minimizes emissions**
  - Emission99 will enable the operator to find a schedule that will minimize air emissions and in this way comply with regulations and

# Step 1: Calculate voyage estimates for all cargoes and ships in the fleet



## Typical emissions from ships

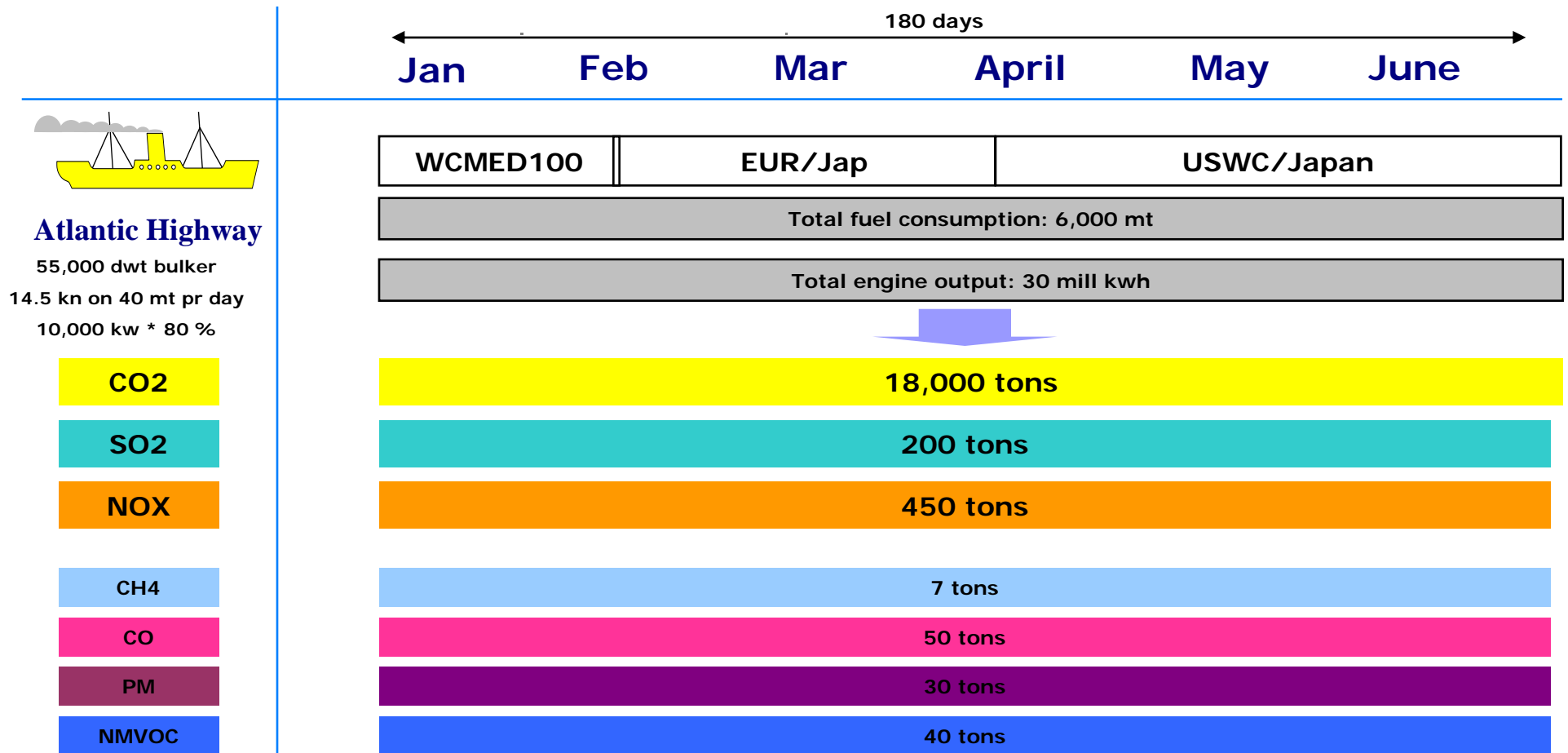
	Fuel based emissions	Engine based emissions (1kwh = 3.6 MJ)
CO <sub>2</sub>	3 kg / kg fuel	
NO <sub>X</sub>		13 – 16 g/kwh
SO <sub>2</sub>	0 – 5 % of fuel consumed	
CH <sub>4</sub>		0.001 g/kwh
CO		0.2 – 2.5 g/kwh
PM		0.3 – 12 g/kwh
NM <sub>VOC</sub> (Non Methane Volatile Organic Carbon)		0.03 g/kwh

# Emission data for ships

The screenshot displays the 'Input Scenario: Panmax - [Ship Data]' application window. The main area is divided into three columns for different ships: INTREPID, Nordkap, and Nordpol. Each column lists technical specifications and emission data. A right-hand sidebar allows for configuring the data view, with 'Ship Emissions' selected. The status bar at the bottom shows the date 11.10.2007 and time 12:23.

Ship: INTREPID	Ship: Nordkap	Ship: Nordpol
INTREPID	Nordkap	Nordpol
IMO Nr:	IMO Nr:	IMO Nr:
Engine function:	Engine function:	Engine function:
Engine builder:	Engine builder:	Engine builder:
Engine make:	Engine make: B&W	Engine make:
Engine model:	Engine model:	Engine model:
Engine type:	Engine type: 7S50MC-MC	Engine type: 7S50MC-MC
Engine number:	Engine number:	Engine number:
Engine Total kW: 10000	Engine Total kW: 9342	Engine Total kW: 11044
Engine speed:	Engine speed: SLOW	Engine speed: SLOW
Engine stroke:	Engine stroke: 2	Engine stroke: 2
Engine RPM:	Engine RPM: 127	Engine RPM: 127
Fuel calorific value:	Fuel calorific value: 190	Fuel calorific value: 190
Engine category:	Engine category:	Engine category:
Engine rating % laden: 80	Engine rating % laden: 80	Engine rating % laden: 80
Engine rating % port: 20	Engine rating % port: 20	Engine rating % port: 20
Engine rating % maneuvering:	Engine rating % maneuvering: 20	Engine rating % maneuvering: 20
Engine rating % ballast:	Engine rating % ballast: 80	Engine rating % ballast: 80
Emission CO2 (kg/kg fuel): 3	Emission CO2 (kg/kg fuel): 3	Emission CO2 (kg/kg fuel): 3
Emission CO:	Emission CO: 2	Emission CO: 2
Emission NOX (g/kwh): 20	Emission NOX (g/kwh): 20	Emission NOX (g/kwh): 20
Emission PM (g/kwh): 10	Emission PM (g/kwh): 1.2	Emission PM (g/kwh): 10
Emission PM-10:	Emission PM-10:	Emission PM-10:
Emission PM-2_5:	Emission PM-2_5:	Emission PM-2_5:
Emission SO2 by fuel: 3	Emission SO2 by fuel: 3	Emission SO2 by fuel: 3
Emission SO2 by engine:	Emission SO2 by engine:	Emission SO2 by engine:
Emission VOC (g/kwh): 6	Emission VOC (g/kwh): 6	Emission VOC (g/kwh): 6

## Step 2: Emissions99 calculates the amount of emissions from this schedule



Emissions are calculated based on parameters given for the ship and the fuel, time at sea, time in port, engine rating for sea versus port etc

## What are costs of emissions ?

- ☞ So far the maritime industry is not paying much for the emissions but this may soon be changing as more and more governments and international organizations are in the process of introducing tariffs and limits for emissions.
- ☞ **Emission99** will allow the operators to test various assumptions about the impact of such emission fees:
  - Cost of purchasing of CO2 quotas for global or regional traffic
  - Low sulphur fuel in European waters
  - NOX charges not only in Norwegian waters but extended to more port areas
  - Introduction of maximum limits for emissions alternatively penalty charges for emissions while in ports

# Specification of emission costs

Input Scenario: Panmax - [Lookup Tables]

File Tasks Data Text document View Analysis Window Help

SHIP CAR GO TLR TAB DIST PER PO VE FILE INP FER SC OP VIS SCHE DIST PA SET SER VOW REP II PO TA STI 5c

Deleting records in tables

**General**

1

Costs relate to area:

Applicable - days from shore:

Price effective from date: 02.06.2007

NOX cost pr ton: 200

NOX cost pr ton currency:

CO2 cost pr ton: 0.5

CO2 cost pr ton currency:

SO2 cost pr ton: 20

SO2 cost pr ton currency:

PM cost pr ton: 30

PM cost pr ton currency:

VOC cost pr ton: 10

VOC cost pr ton currency:

HC Cost pr ton: 6

HC Cost pr ton currency:

CO Cost pr ton: 5

CO Cost pr ton currency:

Notes:

Created by: ERS

Date created: 30.07.2007 16:27:53

Updated by: ERS

Date updated: 21.09.2007 16:41:27

Cargo Various Settings Ship

General

- List of all Companies
- Type of Trade
- Company type

Lookup Tables

- Units
- Weather zone
- Currency types
- Currency rates
- Emission Cost table

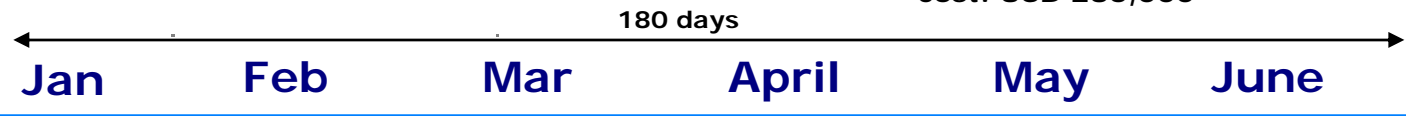
Card view

Query views. Data can be edited.

Status 11.10.2007 12:26

# Step 3: Emissions99 calculates the cost (\*) of emissions from this schedule

Total voyage emission cost: USD 286,000

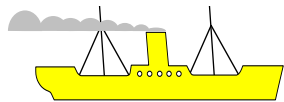


WCMED100	EUR/Jap	USWC/Japan
Total fuel consumption: 6,000 mt		
Total engine output: 30 mill kwh		



CO2	18,000 tons * 10 USD/ton = USD 180,000
SO2	200 tons * 80 USD/ton = USD 16,000
NOX	450 tons * 200 USD/ton = USD 90,000
CH4	7 tons
CO	50 tons
PM	30 tons
NMVOG	40 tons

(\*) Cost of emissions is based on cost pr pollutant as stated by global or local authorities



## Atlantic Highway

55,000 dwt bulker  
 14.5 kn on 40 mt pr day  
 10,000 kw \* 80 %

- CO2
- SO2
- NOX
- CH4
- CO
- PM
- NMVOG

# Emission99: Voyage estimates include emissions costs

**Voyage details**

*Northern Bulk Inc* *Route 99*

**OCEAN EAGLE** 74,085 Dwt 14.00/14.00 on 36.00 /36.00 + Earning points: 367  
 Pool Points: 0

**Australia to Brazil Coal**

Trade ID AU\_BRZ\_CO 44 Days  
 Job Id AUST\_BRZ 7,278 USD/day  
 Laydays 01.07.07 /15.10.07 2.99 Pr dwt month

Voy#: 2  
 Voyage start 25.sep PHU MY  
 Loading start 6.okt DALRYMPLE  
 Voyage ended 8.nov TUBARAO

Base Currency: USD

Cargo: 72,333 mt 14 USD/mt  
 Intake restricted by: Ship dwt: 72333  
 Cargo terms: 3Days SHINC/4Days SHINC  
 Ports: N/A/B/TUB/  
 Sublet rate: 22.00

	Dist	Days at Sea	Days in Port	ETA	ETD
PHU MY					
DALRYMPLE	3,660	10.9	3.0	6.okt	9.okt
TUBARAO	8,883	26.4	4.0	4.nov	8.nov
<b>Days total voyage</b>	<b>44.3</b>	<b>37.3</b>	<b>7.0</b>		

Days waiting  
 Days offshore

Total tons of HVF 1,344 a 365 USD /ton  
 Total tons of MDO a 0 USD /ton

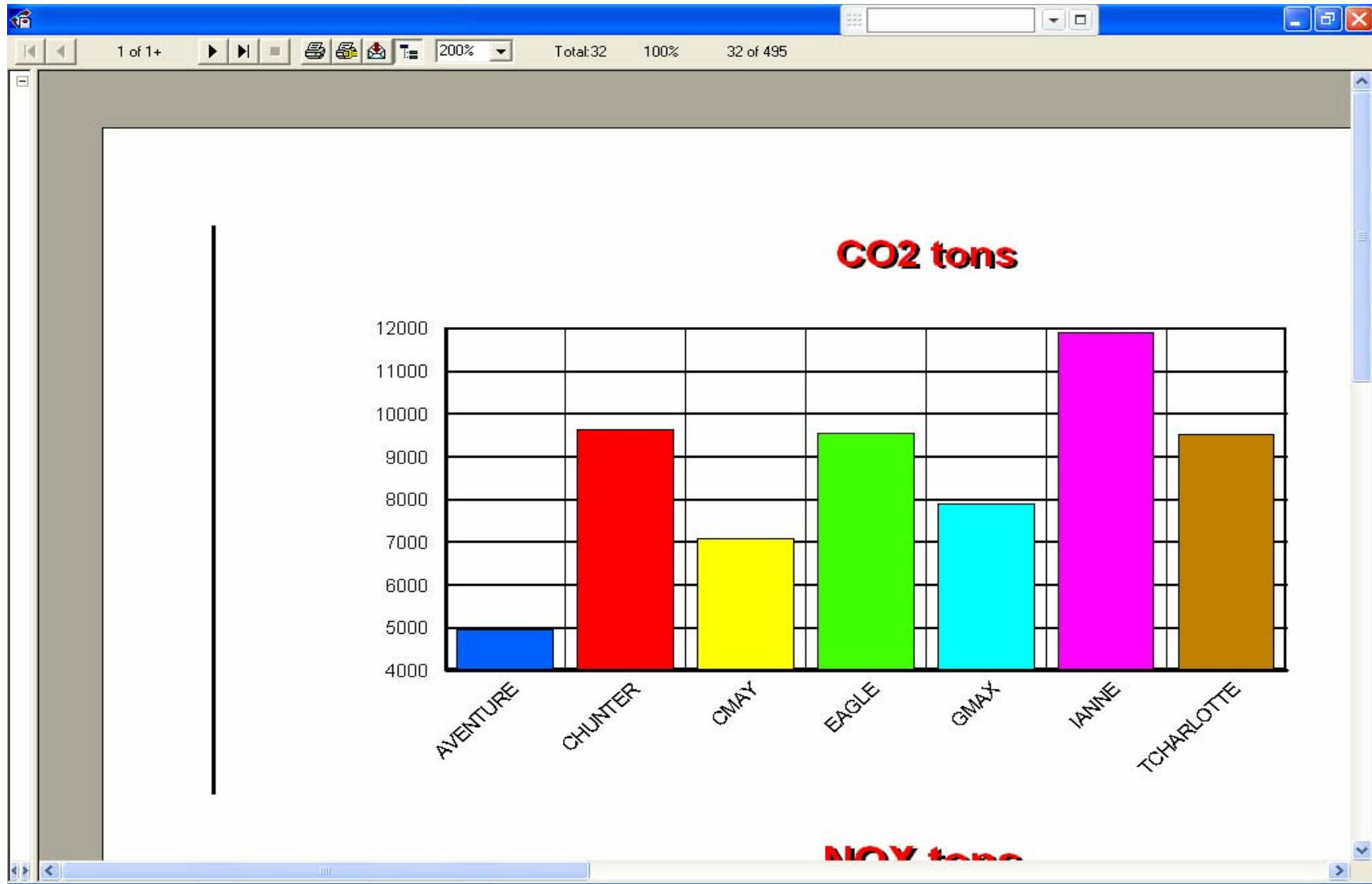
Comments:

Gross Revenue	1,012,662
Total TC Earnings	
Savings on Extra Bunkers	
Bunker Surcharge	
Broker Commission	37,975
Address commission	
Pool Operator Commission	
Handling Costs	
Port Expenses	95,000
Canal Expenses	
Various expenses	
Fuel Expenses	490,560
War risk insurance	
Overhead Cost	
<b>Emission costs</b>	<b>66,481</b>
Demurrage	
<b>TC Result</b>	<b>322,646</b>
TC USD/day	7,278
Budgetted TC pr day	
Pool Point Days (0 * 44.3)	
Market value pr day	
<b>Voyage profit</b>	<b>322,646</b>

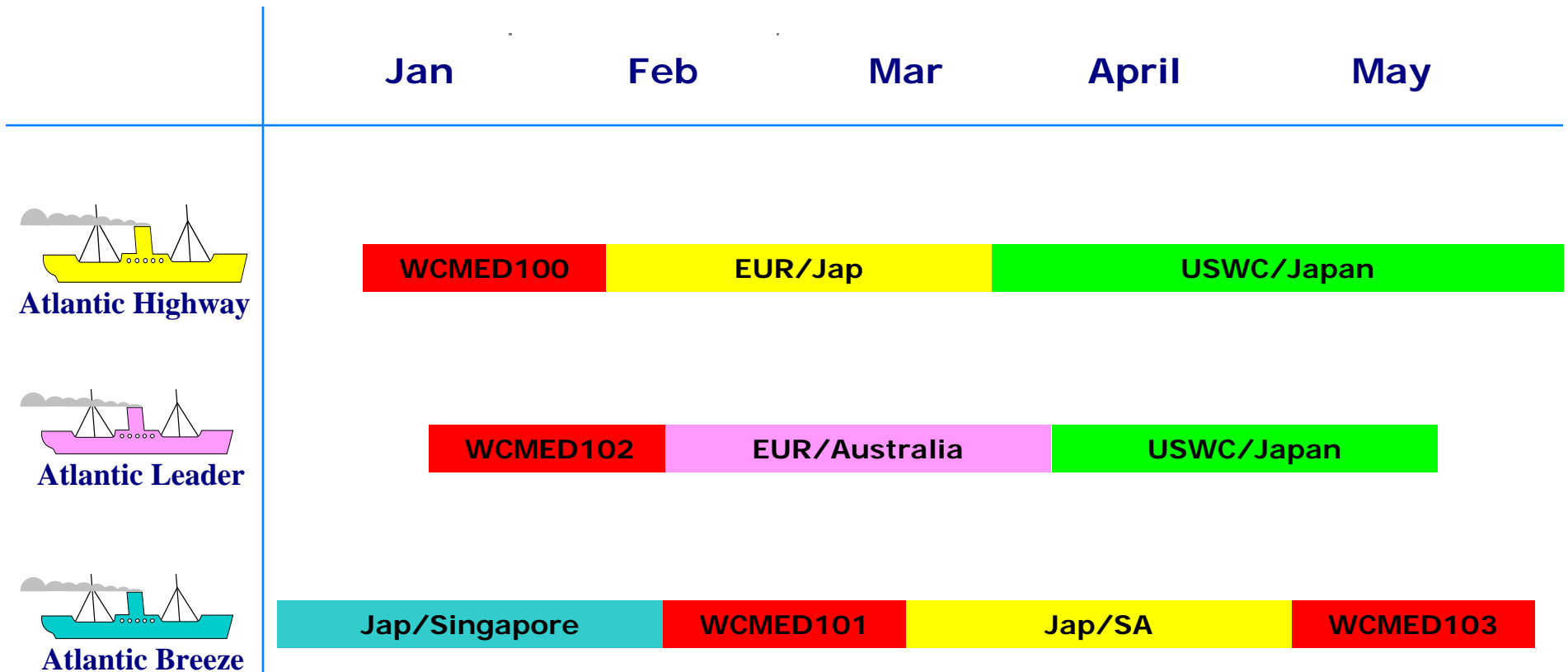
Sch02 - Voyage details Single Cargo  
 11.10.2007 14:11:47 Panmax / BNEW Op 15

Schedule Scenario BNEW Op 15  
 Calculated :11.10.2007 14:11:03 /ERS  
 13

# Emission99: Alternative graphs to present results



**Step 4: Route99 can calculate an optimal (\*) schedule for the fleet that takes into account emissions costs**



(\*) The optimal schedule takes into account all the contractual obligations the operators has along with expected spot business, but in these calculations, emission costs are included as part of the voyage costs

**Illustrative case (\*)**  
**Optimal schedule gives: 20% improvement**

	<b>Manual Schedule as produced by Chartering department</b>	<b>Optimal schedule produced by Route99</b>
<b>Ship days</b>	<b>1,132</b>	<b>1.080</b>
<b>Pro-rated TC result</b>	<b>39.6 mill USD</b>	<b>45.4 mill USD</b>
<b>TC Pr day</b>	<b>35,000</b>	<b>42,000</b>

(\*) A fleet of 6 Handy max bulkers scheduled for a 6 months period against a mix of contract cargoes/spot jobs and TC contracts.

# Ships to be scheduled

Route99 - [The Scheduler]

File View Data Voyage Accounting Analysis Tools Window Help


Schedule scenario: Pluto Op 4

Ships	Jobs and cargoes	Settings					
Selec...	Ship ▲	Open in Port	Date open	Earliest termina...	Latest terminat...	Shipment Reso...	TC Cost Pr day
<input checked="" type="checkbox"/>	Atlantic Rider	NEW ORLEANS	17.01.2003	30.06.2003	15.08.2003	OWN	
<input checked="" type="checkbox"/>	Atlantic Sailor	BURNTISLAND	18.01.2003	01.05.2003	15.08.2003	TC	4000
<input checked="" type="checkbox"/>	Bright Fortuna	SAINT JOHN	23.01.2003	30.06.2003	15.08.2003	OWN	
<input checked="" type="checkbox"/>	Bright Hope	ROTTERDAM	30.01.2003	01.04.2003	01.06.2003	OWN	
<input checked="" type="checkbox"/>	Cape Jaffa	TAKAO	27.12.2002	01.06.2003	07.09.2003	OWN	0
<input checked="" type="checkbox"/>	Cape Nelson	AALBORG	29.12.2002	01.06.2003	07.09.2003	OWN	0
<input checked="" type="checkbox"/>	Cape York	MOBILE	01.01.2003	01.06.2003	07.09.2003	OWN	0
<input checked="" type="checkbox"/>	Federal Commander	ROTTERDAM	06.02.2003	30.06.2003	15.08.2003	TC	6500
<input checked="" type="checkbox"/>	Federal Runner	DUBLIN	18.01.2003	30.06.2003	15.08.2003	OWN	

9 ships to be included in the scheduling.

Own / pool ships  
 Long term TC Ships  
 TC Candidates  
 All ships

Show only ships selected for this scheduling  
 Table form



Ship Data

**Run scheduler**

Find an optimal Schedule

Show data check

Check data consistency

Check feasibility of the input schedule

Run optimisation with Biased schedule

Cancel

Status: 08.01.2003 15:28

# Cargoes to be lifted - details

Route99 - [The Scheduler]

File View Data Voyage Accounting Analysis Tools Window Help

Schedule scenario: Pluto Op 4


Ships Jobs and cargoes Settings

Drag a column header here to group by that column.

Sel...	Job ID	Trade ID	Name of trade	Est. ...	Qua...	Freight Rat...	Opening Layday	Closing Layday
<input checked="" type="checkbox"/>	666	AIG	ALCOA Italy/Germany	1	<input type="checkbox"/>		01.04.2003	30.06.2003
<input checked="" type="checkbox"/>	100	CFW	Cetrappa France/West Africa	6	<input type="checkbox"/>		20.12.2002	30.06.2003
<input checked="" type="checkbox"/>	60	ARB	Argentina/Black sea	12	<input type="checkbox"/>	30	10.12.2002	30.06.2003
<input checked="" type="checkbox"/>	52	GGA	Grain USG/ARA	15	<input type="checkbox"/>	15.8	10.12.2002	30.06.2003
<input checked="" type="checkbox"/>	53	GGA	Grain USG/ARA	15	<input type="checkbox"/>	14.6	10.12.2002	30.06.2003
<input checked="" type="checkbox"/>	621	CGUK	Cabocoal USG/UK	1	<input type="checkbox"/>	28	01.03.2003	31.03.2003
<input checked="" type="checkbox"/>	623	CGUK	Cabocoal USG/UK	1	<input type="checkbox"/>	29.4	01.06.2003	30.06.2003
<input checked="" type="checkbox"/>	620	CGUK	Cabocoal USG/UK	1	<input type="checkbox"/>	28	01.02.2003	28.02.2003
<input checked="" type="checkbox"/>	105	COBSN	Cobelfret Spain/Nigeria	12	<input type="checkbox"/>		20.12.2002	30.06.2003
<input checked="" type="checkbox"/>	505	ADVE	Aalborg Cement Denm/Venez	1	<input type="checkbox"/>		01.06.2003	30.06.2003
<input checked="" type="checkbox"/>	51	GGA	Grain USG/ARA	15	<input type="checkbox"/>	16.9	10.12.2002	30.06.2003
<input checked="" type="checkbox"/>	643	DUD	Danpower USEC/Denmark	1	<input type="checkbox"/>	13.5	01.04.2003	30.04.2003
<input checked="" type="checkbox"/>	636	RGUK	Reynolds Guyana/UK	1	<input type="checkbox"/>		01.02.2003	15.03.2003
<input checked="" type="checkbox"/>	8000	RAE	Reynolds Australia/Egypt	6	<input type="checkbox"/>		01.01.2003	30.06.2003
<input checked="" type="checkbox"/>	7777	BRF	Blue Circle Rotterdam/Florida	2	<input type="checkbox"/>		07.02.2003	02.05.2003
<input checked="" type="checkbox"/>	670	WUG	WeserCoal US/Germany	3	<input type="checkbox"/>		20.12.2002	30.06.2003
<input checked="" type="checkbox"/>	43	GUA	Grain USNH/ARA	15	<input type="checkbox"/>	11.6	10.12.2002	30.06.2003
<input type="checkbox"/>	50	CGA	Grain USG/ARA	15	<input type="checkbox"/>	20.4	10.12.2002	30.06.2003

54 Spot cargoes

Spot cargoes   
  TC Jobs   
  Only jobs selected for scheduler  
 Contract cargoes   
  Dry dockings   
  Forced or minimum lifting jobs  
 Quantity contracts   
  Jobs Not selected   
 Table form  
 Supply jobs



Job and contract data

Run scheduler

Find an optimal Schedule

Show data check

Check data consistency

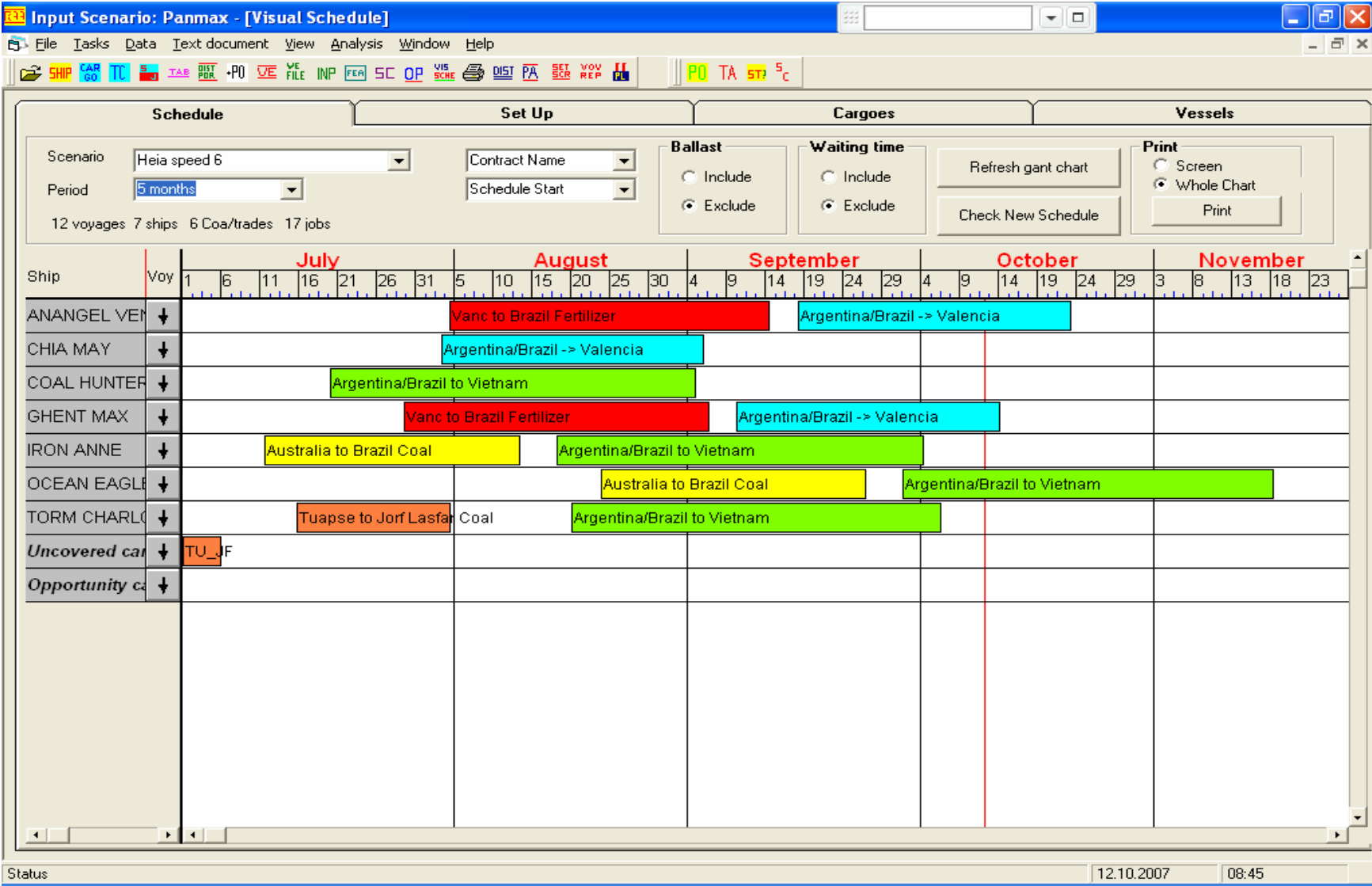
Check feasibility of the input schedule

Run optimisation with Biased schedule

Cancel

Status: 08.01.2003 15:42

# Visual Scheduling



## **DNV and Emission99**

- ☞ **Environmental issues are getting more and more attention**
- ☞ **Tool for evaluating economic and operational effects of emission**
- ☞ **Tool for fleet scheduling from a P&L standpoint**
  - **Optimal schedule**
  - **Tonnage budgeting**
  - **Risk management**
- ☞ **Proposals:**
  - **DNV uses Emission99/Route99 as an internal tool and contribute in further development with NMS**
  - **DNV offers software package to customers for use in technical and operational departments**